

17. Prove that any point P of a moving in viscid fluid the pressure P is the same in all directions.
18. A three dimensional doublet of strength μ whose axis is in the direction $\overline{ox}$ is distant a from a rigid plane $x = 0$ which is the sole boundary of liquid of density ρ , infinite in extent. Find a pressure at a point on the boundary distant 'r' from the doublet given that the pressure at infinity is P_∞ . Show that the pressure on the plane is least at a distance $a\sqrt{5/2}$ from the doublet.
19. Show that for irrotational incompressible two dimensional flow (steady or unsteady) $\phi(x, y)$, $\psi(x, y)$ are harmonic functions and the families of curves ϕ -constant (equipotentials) and $\psi = \text{constant}$ (streamlines) intersect orthogonally.
20. Derive the relation between Cartesian components of stress.

NOVEMBER/DECEMBER 2025

23PEMA35B — FLUID DYNAMICS

Time : Three hours

Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. What is meant by streamline?
2. Define unit vortex tube.
3. Write the Euler's equation of motion.
4. When we say the pressure is hydrostatic?
5. Define simple source.
6. When streamlines are paths of fluid particles?
7. Define stream function.
8. Define uniform line vortex.
9. What are the components of stress?
10. What is meant by coefficient of viscosity?



SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL questions.

11. (a) Explain the velocity of a fluid at a point.

Or

- (b) For an incompressible fluid $\vec{q} = [-wy, wx, 0]$ ($w = \text{constant}$). Discuss the nature of the flow.

12. (a) Derive Bernoulli's equation.

Or

- (b) A long pipe is of length l and has slowly tapering cross section. It is inclined at angle α to the horizontal and water flows steadily through it from the upper to the lower end. The section at the upper end has twice the radius of the lower end. At the lower end, the water is delivered at atmospheric pressure. If the pressure at the upper end is twice atmospheric. Find the velocity of delivery.

13. (a) Discuss a doublet in a uniform stream.

Or

- (b) Explain uniform stream and simple stream.

14. (a) Show that the image of a line source in a rigid infinite plane is a line source of equal strength at the optical image in the plane of the point at which the given line source is situated.

Or

- (b) Derive the image of a line source in a circular cylinder.

15. (a) Explain the translational motion of fluid element.

Or

- (b) Explain the stress components in a real fluid.

SECTION C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

16. Test whether the motion specified by $\vec{q} = \frac{K^2(x\vec{j} - y\vec{i})}{x^2 + y^2}$ ($k = \text{constant}$) is a possible motion for an incompressible fluid. If so, determine the equations of the streamlines. Also test whether the motion is of the potential kind and if so determine the velocity potential.